Mobile Haptic System Design to Evoke Relaxation through Paced Breathing

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Figure 1: *(a) Participant using device. (b) Participant inserting phone into pillow pocket. (c) Biofeedback system diagram.*

1 Introduction

Stress is physical response that affects everyone in varying degrees. Throughout history, people have developed various practices to help cope with stress. Many of these practices focus on bringing awareness to the body and breath. Studies have shown that mindfulness meditation and paced breathing are effective tools for stress management [Brown, 2005].

Within the past year there have been huge strides in development and commercial interest regarding portable tools for health and fitness. There are a number of mobile applications currently available that are designed to guide the breath to support mindfulness meditation and paced breathing practices. These focus mainly on audio/visual cues, and not haptic cues. However, touch is an extremely personal and intimate sense. It is used to create a personal space, only experienced to those directly exposed to the action. Although, tactile exploration is underexplored in this particular area, there is evidence of the sense of touch being incorporated in traditional relaxation practices (e.g. stress balls, baoding balls, prayer beads). Available paced breathing applications are also mostly non-interactive. Those that are interactive read and display physiological data, but do not use this data to further tailor the experience to the user.

Our goal is to develop a mobile paced breathing tool focusing on haptic cues and biofeedback to explore the following questions: Do users prefer manual or biofeedback control? How effective is haptic guidance on its own? How may the addition of haptic feedback enhance audio based guidance?

2 Our Approach

A paced breathing mobile phone application has been developed in Android Studio to aid in the exploration of these questions. The application is able to produce either haptic (vibrational pulses), audio (gong chimes), or audio-haptic (vibrational pulses and gong chimes) outputs to act as a breathing guide for the user. During use of the application, the user is instructed to begin each inhalation and exhalation along with each vibrational pulse and/or gong chime. A small pillow with a pocket was fabricated in order to hold the mobile device, provide the user a place to comfortably rest their hands, and smooth and amplify the haptic experience.

The haptic guide was created using the Immersion Haptic SDK. It employs the phone's motor to provide gentle vibrational pulses. The audio guide essentially plays a music file of a synthesized gong chime. Both of these prompts are looped according to a timer interval determined by the target breathing rate. This creates a breathing guide to aid the user in pacing their own breath.

There are also two primary modes of interaction (manual and biofeedback) within the app to determine the target breathing rate. During the manual mode, the user has the ability to directly adjust the interval length of the breathing guide through an on-screen slider. In the biofeedback mode, the application communicates via Bluetooth with a Zephyr BioHarness sensor worn by the user in order to determine the user's current breathing rate. The breathing guide is initially set to match the user's rate, slowly increasing the interval of the guide to decrease the user's breathing rate. Throughout the session, the program monitors the user's ability to match the guide and adjusts the breathing interval accordingly.

The different output modes allow the user to utilize the system in various conditions. For instance, the haptic guide may be appropriate if the user desires a quiet subtle guide for their breath. The audio guide would be more suitable if the user is working and requires their hands to be free. The audio haptic guide would be effective if the user desires a more immersive experience. Additionally, the various interaction modes allow flexibility for the desired type of control. If the user prefers direct control over the target breathing rate or wants to go straight into deep breathing, they may decide to use the manual interaction mode. However, if the user is unsure where to set the target breathing rate or wants to gradually fall into deep breathing, they may choose to use the biofeedback mode, so they can be guided to a slower paced breath from their current breathing state.

References

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